CEREAL SCIENCE today

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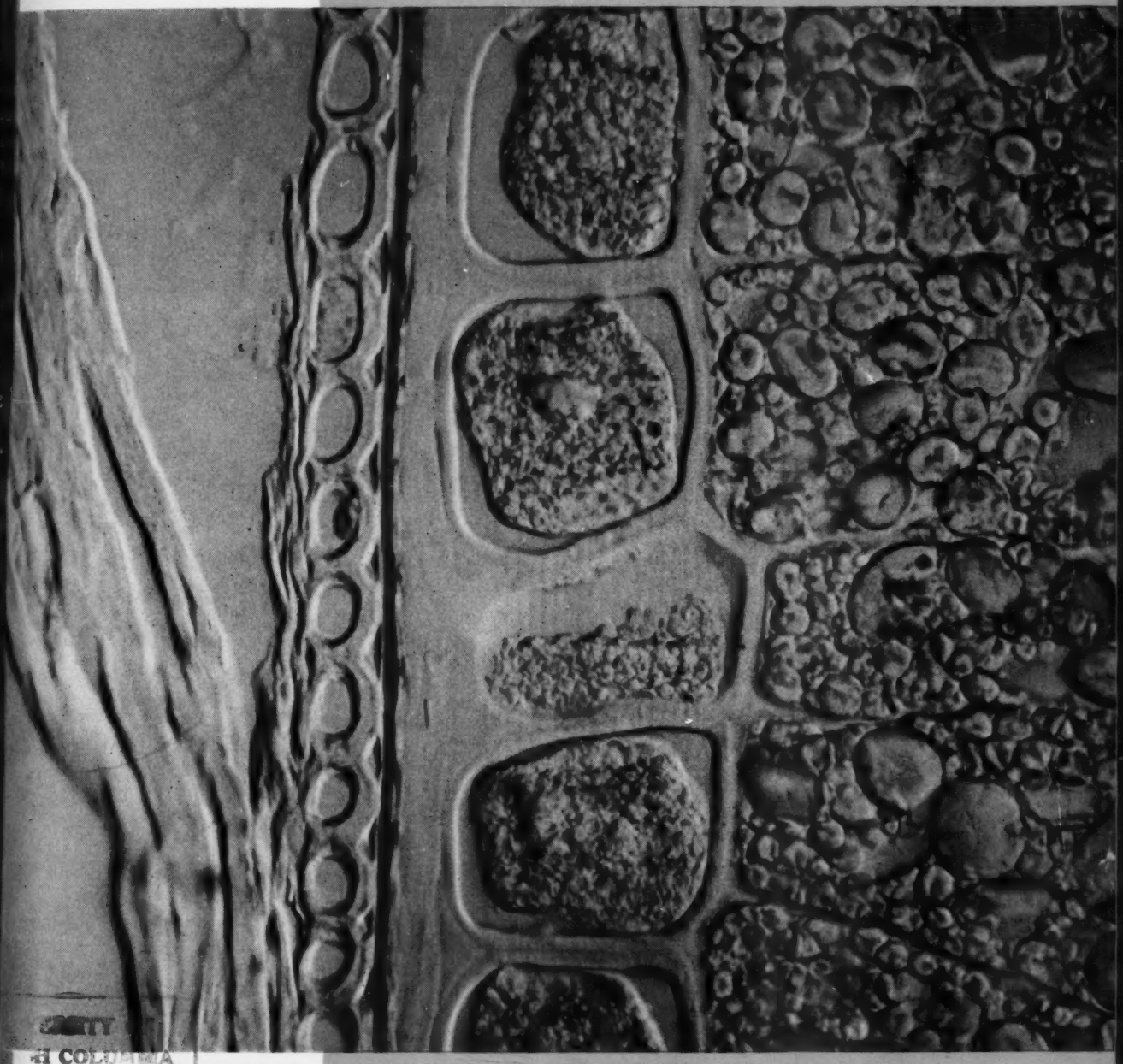

AN OFFICIAL PUBLICATION OF THE AMERICAN ASSOCIATION OF CEREAL CHEMISTS

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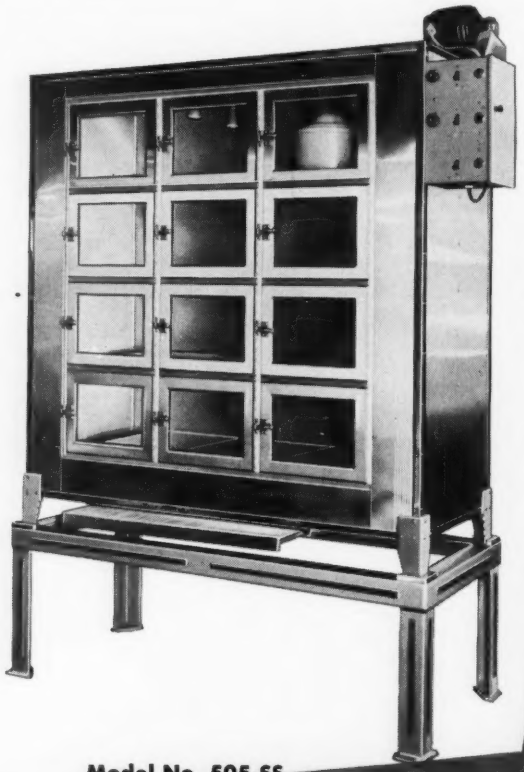

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CERTIFIED CHEMICAL EQUIPMENT MANUFACTURER

NATIONAL MFG. COMPANY
LINCOLN, NEBRASKA

VOLUME 1 • NUMBER 6 • DECEMBER 1956

CEREAL SCIENCE today

FEATURES

TECHNICAL SECTION

DEPARTMENTS

STAFF

COVER: An unstained cross section of the wheat berry (approximately 750 diameters). Prepared and photographed by Richard I. Derby, Physics Department, Research Laboratories, General Mills, Inc. (see page 204 for details).

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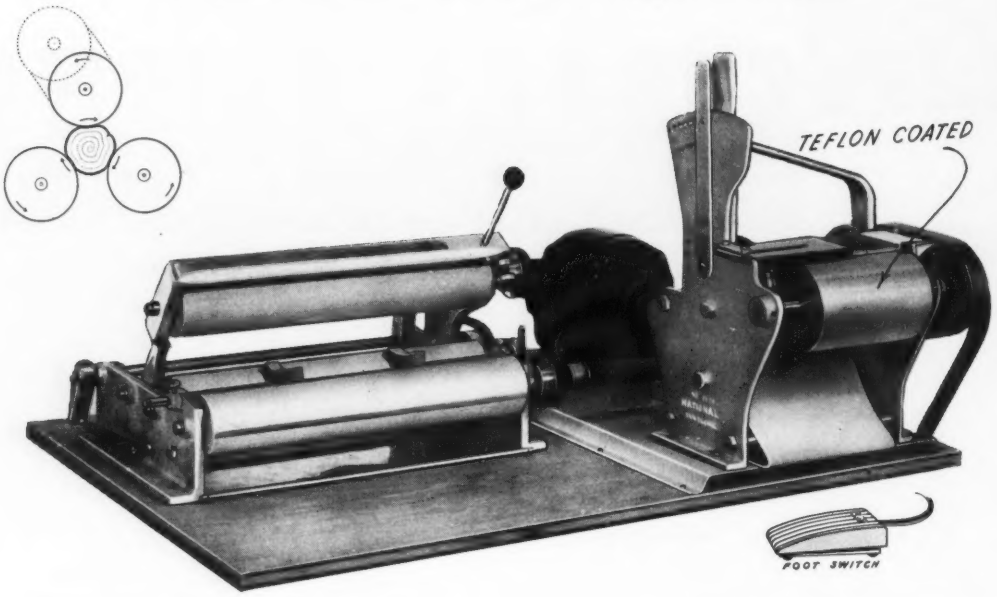

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CEREAL CHEMISTS' EQUIPMENT MANUFACTURER

NATIONAL MFG. COMPANY
LINCOLN, NEBRASKA

Editorial

THE COMPETITION IN the food industry for the consumer's food dollar was never before as keen as it is today. One only has to stroll through one of our modern, serve yourself, super food markets to realize that Mrs. Consumer has a tremendous choice of attractively packaged and advertised foods from which she must make her selection to feed her family. It is conservatively estimated that there are today some ten thousand food items from which this selection is made.

Thus the cereal chemist was never before faced with such a challenge to see to it that *grain products foods* hold their place with all the other types and kinds of foods. The cereal chemist should be the "architect" for new and diversified foods, appetizing and nutritionally good. The grain product foods were never held in higher esteem than at present. Through a more accurate knowledge of what cereal grains contribute in terms of essential nutrients, through widespread utilization of enrichment fortification, and restoration for processed cereal foods, this group of foods has indeed a bright future.

The number one concern today with doctors and nutritionists is obesity, and the number one killer today seemingly is with those that suffer from hardening of the arteries, coronary difficulty and heart failure. The medical authorities are mostly all agreed that the ingest of fats in the American diet is too high, supplying on the average 40% or more of our total calories. They are recommending a cutback in fats. To replace these food calories there is no group of foods that offer a better and safer replacement than grain product foods.

Therefore, the cereal chemist is confronted with an opportunity and a challenge to create, formulate, interpret and intelligently present new cereal foods. And in doing so he will be most constructive in assisting his company and industry in gaining a larger percentage of the consumer's food dollar. Also he will have the personal satisfaction that his contribution will be in the consumer's best interest, resulting in better general public health.

G. CULLEN THOMAS

NEEDS, OBJECTIVES AND PROBLEMS IN

Cereal Research in Belgium

By E. Maes*

BELGIUM'S POPULATION OF 8,800,000 annually consumes the flour from a million tons of wheat, extracted at the prevailing rate of 75% and without bleaching or oxidizing treatment, according to law. To supplement an average yearly production varying from 400,000 to 650,000 tons, some 350,000 to 600,000 tons of wheat must be imported. The origin and quantity of imports for the years 1953 to 1955 are shown in the accompanying table.

BELGIAN WHEAT IMPORTS, 1953–1955

WHEAT TYPE	CROP YEAR	
	1953–54	1954–55
	%	%
Manitoba (Canada)	48.0	58.0
Hard winters, springs, and white	5.6	16.7
Red winter	5.6	6.0
Soft white	1.6	2.6
Plata (Argentine)	18.7	10.4
Russian and Bulgarian	20.2	4.3
All others	0.3	2.0

Environmental conditions in Belgium are such that its wheat has insufficient strength for bread-baking purposes, and hence the imported wheat must make up the deficiency. Belgian wheat of the 1955 crop was unusually low in protein content, averaging 9%; diastatic activity also was low. The 1954 crop contained a great deal of sprouted grain, in some cases as much as 40% but averaging 3.5%.

Belgian mills experience economic difficulties as well. At the Port of Antwerp the best North American wheats cost from 390 to 410 Belgian francs (B.f.) per 100 kg. ($7.80 to $8.20 per 220.5 lbs.), and soft wheat 360 B.f. ($7.20). The milling industry is compelled to use 65% local wheat, which presently costs 470 B.f. ($9.40).

Belgian Research Institutes

It is evident from the foregoing that there are numerous problems associated with wheat production, processing, baking, and research in Belgium. The following institutes are conducting research on these problems:

Wheat breeding:
- State Agricultural Institute, Gembloux
- Agricultural Institute, Catholic University, Louvain

Milling research:
- College for Industrial Fermentations, Ghent

Baking research:
- National Center for Technical Aid and Applied Research (CENATRA), Antwerp

Basic research:
- Biochemical Institute, Catholic University, Louvain
- Education and Research Center for Food Industries (CERIA), Brussels
- Central Laboratory, Ministry of Economic Affairs, Brussels

Several of these institutes receive grants for scientific research from the Institute for Encouragement of Scientific Research in Industry and Agriculture (IRSIA), which provides necessary funds without practical participation in the research.[1]

Cereal Research — Wheat Breeding

Until a few years ago, the main objective of wheat breeding research was to develop wheats with high yields and resistance to frost and disease. More recently, since it has become compulsory for the milling industry to use a certain amount of local wheat, the baking quality of new varieties has been investigated. At present, about fifty varieties are tested each year using various analytical, baking, and physical dough-testing methods. The ash, protein, wet and dry gluten, fermentation time, maltose value, Chopin Alveograph, Brabender Farinograph, and baking tests are performed on flour of 60% extraction, milled with a Bühler experimental mill.

Thus far, the testing program has not brought about any important change in the quality of local wheats. Results reported by the Wheat Breeding Institute indicate that wheat varieties with high yield have poor baking quality. With local wheat costing nearly 15% more than imported wheat of good quality, the milling industry has shown no inclination to offer a higher price to farmers for producing higher-quality soft wheat. Therefore, it is difficult to persuade farmers to grow other than the highest-yielding wheat varieties.

Milling Research

Research is under way to determine the milling value of local wheats and the maximum amount that can be combined with imported varieties without undue deterioration of normal baking quality of the flour produced. Evaluation of milling quality is based on bran and germ weight, volume of 1000 kernels, density and thickness of the outer kernel coverings, and hectoliter (bushel) weight. A small commercial mill is used for

* Professor of Cereal Chemistry at the College for Industrial Fermentations, Ghent; Director of the Central Laboratory, Ministry of Economic Affairs, Brussels; and Research Director of the National Center for Technical Aid and Applied Research, Antwerp. Paper presented at the 41st annual meeting, A.A.C.C., New York, May 1956.

[1] Results are published in *Bulletin de l'École de la Meunerie Belge, Revue de Fermentation et des Industries Alimentaires,* and journals of several other nations.

these experiments.

Bran thickness is fairly constant for a given variety. There is no relationship between the thickness of the aleurone layer and other outer coverings. Dark wheats in general have a thicker bran layer than white wheats; and spring wheats have thicker bran than winter wheats. Thickness is influenced by moisture content and size of the crease.

The relationship between moisture content and bushel weight has been studied. It was found that the weight per unit volume remains practically constant through the 12 to 16% moisture range, but decreases rapidly in the 17 to 22% range.

Among other research efforts are the investigation of errors in the determination of moisture in grains, the use of infrared irradiation to reduce the rate of increase of fat acidity during storage, the development of better techniques for heating flour to improve its baking quality, and the use of selected barley varieties for the production of malt supplements for the milling industry. If germination is stopped in time, diastatic power is greater, and proteolytic activity is less. The response of flour milled from local wheat to additions of ascorbic acid and malted wheat flour has been investigated. Both products are being used more and more in the milling industry.

Baking Research

"Brown-and-serve" products, saltless bread, surface-active agents, and high-frequency heat in baking are being investigated. Response to the use of glycerine in baked products was not favorable. The so-called "polys" are tolerated, and their use and action has been under study for several years. Oil-in-water emulsions containing at least 10% polys gave the best results as measured by loaf volume, grain, texture, and staling rate.

Whereas the normal fermentation period is 3 to 5 hours, recently the entire baking process has been carried out in less than 20 minutes, with a continuous dough mixing process requiring only 3 to 4 minutes and a very slack dough, the usual yeast concentration being replaced by a peroxide solution plus a little yeast. Baking time in a high-frequency field is only 7 minutes, but crust formation in an infrared oven requires 10 additional minutes. Loaf characteristics are good, and baking losses are about the same as in the standard procedure. Crumb structure can be changed readily from very fine to very coarse; and the bread remains fresh longer than that produced by the usual procedures. If desired, the usual additives or improvers such as salt, malt, and polys can be used.

Analytical Methods

The Pelshenke test has been adopted for flour, and a simple device has been built for measuring the volume of the dough ball during fermentation. Ash content of the initial flour is measured by a newly developed method based on the ash and salt content of the bread. Ultraviolet irradiation of flour and its components and the influence of proteolytic enzymes produced by microorganisms as compared with that of the enzymes naturally present in flour are being investigated.

A modification of the technique for determining particle size of flour is in use: the flour particles are allowed to settle in a test tube, and light transmission of the suspension is measured by means of an ordinary colorimeter. Light transmission is plotted as a function of the settling time.

The Zeleny sedimentation test has been applied to weak wheats and the results compared with Pelshenke test values, but no useful relationship was observed. A semicontinuous apparatus for conducting the filth test has been developed and further work is in progress.

The exact determination of the water absorption of weak flours receives much attention and two methods have been developed: In the first, flour suspension with water is centrifuged, the supernatant clear liquid removed, and the remaining material weighed; this gives the correct dough absorption to within $\pm 0.5\%$. The other method uses a simple penetrometer, obtaining results as accurate as those recorded with the farinograph and better agreement with baking.

Basic Research

An investigation on the electrophoretic behavior of gluten in lactate and acetate buffers indicates that at least three principal and two secondary components are present. Gluten is nearly entirely soluble in 2 to 4 *M* aqueous solutions of dimethylformamide, and from these solutions water-soluble gluten can be obtained by dialysis against distilled water. The film, after drying, is water-soluble and becomes insoluble after stretching. This reformed gluten can be redissolved in aqueous dimethylformamide. These solutions slowly retrograde, especially at higher temperatures. This change seems to be similar to the $\alpha \rightarrow \theta$ conversion in the structure of the polypeptide chain, as described for the fibroin of silk. An attempt is being made to separate the polypeptides of gluten.

A great deal of study is given to the chemical and physical properties of wheat proteins. Progress has been made toward the first objective, to achieve complete solubility of the protein without denaturation. Lyophilized gluten can be stored without denaturation, oxidation, or proteolysis, with reproducible and quantitative results. About 50% of gluten, plus an equal volume of pyridine, dioxanacetone, or ethanol, is solubilized by slow mechanical agitation in water. Nearly complete solubilization can be obtained under the same conditions by vigorous agitation in a Waring Blendor. The gluten can be reprecipitated from these solutions without apparent alteration of its original mechanical and solubility properties. Using water and a Waring Blendor, solubility may vary from 3 to 50%. At pH 11 an aqueous solution can be obtained. The differences in solubility of gluten in water are thought to be due to oxidation of the protein. This interpretation is based on the fact that gluten is rapidly and completely dissolved in *M*/100 reducing solutions at pH 11 and 0° C. with slow stirring. The solubility in water at pH 11.0 under the same conditions varies with the sample. Reducing substances that can be used are sodium sulfide, cyanide, cysteine, thioglycolate, and ascorbic acid. Precipitations of the reduced proteins at pH 6.0 result in proteins with no elasticity. Electrophoretic studies of these solutions are in progress.

Summary

The main objective of cereal technology in Belgium is to improve the baking quality of local wheat; and we are ready to carry our share of fundamental research in cereal chemistry, milling, and baking.

OUR BRITISH CORRESPONDENT REPORTS ON THE

Dublin Symposium on Yeast Studies

By C. R. Jones*

IN RUPERT GUINESS Hall, Dublin, on September 17–19, 1956, the Society of Chemical Industry sponsored the Dublin Symposium on "Recent studies in yeast and their significance in industry." Visitors from Australia, Denmark, Holland, France, and Germany were among the 130 members and guests attending the symposium. A lively interest was apparent in the papers which dealt with aspects of yeast growth and the utilization of foodstuffs by yeast.

Applying quantitative paper chromatography to the aqueous-ethanol extract of a strong Scottish-milled flour, R. M. McKenzie of Distillers Company demonstrated the presence of 0.04% fructose and glucose, 0.27% sucrose, 0.33% glucodifructose, 0.17% raffinose, and 0.45% levosine. His paper described "The utilization of flour sugars during panary fermentation," including changes in their concentration.

A. A. Eddy of the Brewing Industry Research Foundation, speaking on "Some chemical aspects of yeast growth," explained a simple test he has developed for determining to what extent yeast of the genus *Saccharomyces* may be infected with wild yeasts from other genera. The test is based on the respective abilities of these yeasts to utilize lysine as a source of nitrogen for growth.

"Inositol deficiency in yeast with particular reference to fat production" was discussed by S. W. Challinor of the University of Birmingham. Yeast cells grown in media containing suboptimal amounts of inositol, he reported, become very unhealthy and fragile and contain 22–24% (ten times normal) of fat soluble in light petroleum. The cell walls, Mr. Challinor said, contain appreciably less protein than do the walls of normal cells.

R. H. Hopkins, also of the University of Birmingham, spoke on "Amylase systems in brewery yeasts." He said that while glucose, maltose, and maltotriose are the only starch fission products fermentable by brewery yeasts, these yeasts secrete a debranching enzyme (sometimes called "isoamylase") which splits the alpha-1:6 linkage in amylopectin and its beta-limit-dextrin. It splits about 60% of these substrates, the residue being resistant, and is active up to 50°C. Mr. Hopkins called attention to the interesting yeasts, including *S. diastaticus*, that can ferment starch. These have been found in bottled beer. They secrete glucamylase (amyloglucosidase), an amylase akin to beta-amylase but splitting beta-glucose, instead of beta-maltose, from the substrate molecule. They are of potential industrial significance in the production of ethanol from starchy materials.

"Measurement of levels of metabolites within the yeast cell during fermentation" was treated in a paper by three authors representing Distillers Company — P. F. E. Mann, W. E. Trevelyan, and J. S. Harrison. By chromatographic and other analytical methods they studied the metabolites present in extracts from baker's yeast which had been fermenting glucose. Quantitative measurements supported the hypothesis that the enzymes which catalyze the reversible reactions of fermentation are in excess, so that their substrates are in equilibrium at the steady stage of fermentation. It was explained that an absolute limitation in the rate of fermentation (in simple media) is caused by the saturation of the irreversible enzyme carboxylase by its substrate pyruvate, but this limitation can be removed by the addition of thiamine to the medium.

E. J. Conway of University College, Dublin, explained, in his paper on "Active transport across the yeast cell membrane," that the manner of entrance of foodstuffs into the yeast cell during fermentation is not by passive diffusion; instead, they are actively transported, by various carriers, across the cell wall or membrane, which holds a preponderance of fixed anion charges. The mechanism for glucose, he continued, appears closely similar to that operating in the tissue cells of animal organs, and involves the activity of the hexokinase system. Potassium ions and a considerable proportion of the ammonium ions are taken up by a redox carrier of the cytochrome type. This can actively transport any of the inorganic cations during fermentation but with widely different affinities, Mr. Conway said. Thus the affinities for potassium, sodium, and magnesium are in the proportions 400:16:1. The carrier operates by receiving a certain fraction of the total metabolic hydrogen atoms which are liberated to acceptors during fermentation. These are converted into electrons and free hydrogen ions. The reduced form of the carrier which has received electrons forms an adsorption complex with the cation which it transports across the membrane.

Respiration by yeast in relation to its rate of growth and yield was reviewed by P. Slonimski of the University of Paris.

H. Holzer of the University of Hamburg ("Regulation of carbohy-

* Cereals Research Station, Old London Road, St. Albans, Herts., England.

drate metabolism in yeast cells") showed that the addition of ammonium salts increases several times the initial rate of fermentation of glucose by yeast cells, the increase commencing within a few minutes from the moment of addition.

J. White of Fardon's Vinegar Co. spoke on "The influence of environmental factors on yeast behavior." The large literature accumulating on yeast genetics, he said, justifies the hope that eventually there will be spectacular practical results in the emergence of new yeast strains of industrial value. But R. B. Gilliland (Arthur Guiness Son & Co., Dublin: "Yeast genetics in industry") points out that there have so far been very few reports of successful attempts to improve commercial yeasts by means of hybridization. From his study of the properties of recently produced polyploid *Saccharomyces*, Mr. Gilliland suggests that these may have application in industry.

R. R. Fowell, Distillers Co. ("Some genetical aspects of panary fermentation") gave data indicating that the rate of gas production by baker's yeast in dough is controlled primarily by a small number of major genes. Data for the early stage of fermentation (involving the utilization of easily fermentable sugars present initially), he said, can be explained in terms of four major genes operating with dominance. Those for the later stage (involving utilization of diastatically produced maltose) require a more complicated hypothesis involving four genes operating positively and five acting negatively.

In the paper mentioned above, Mr. White emphasized the importance of environmental factors during production in regard to keeping quality and subsequent fermentative activity of the yeast. Yeasts used in breadmaking which are incrementally fed (that is, sugar-containing nutrients are added gradually to an aqueous suspension of the yeast) are, he pointed out, much less osmosensitive and generally more stable than the yeasts from brewing, which are not so fed. Osmosensitivity increases with increasing growth rate. Mr. White believes that this property (osmosensitivity) might underlie differences in behavior of some yeasts in white and brown flour doughs. With yeasts grown by direct culture, the stage of harvesting and the nature of the sugar present in the growth medium, he said, affect the ability of the yeast to ferment maltose and glucose and also to secrete invertase.

A. J. Amos (Dudden Hill Laboratories, London), chairman of the Food Group of the Society of Chemical Industry, contributed to the program with introductory remarks in opening a session. J. B. M. Coppock (British Baking Industries, R. A. Chorley Wood), gave an official summary of the proceedings from the point of view of the baking industry. (A summary from the brewing point of view was given by A. H. Cooke.) Mr. Amos and Mr. Coppock both stressed that, while the chief function of yeast in breadmaking is to provide the gas necessary for leavening, it is also important in producing flavor, and there is great need and scope for research in this field.

Mr. Coppock also put the interesting suggestion that possible occasional production of raffiinose during dough fermentation might be associated with mutations arising from yeast hybridization. This particular sugar might be responsible for the occasional inexplicable crumb sticki-

(Please turn to page 198)

MICRONUTRIENT PROBLEMS IN FEED FORMULATION[1]

J. R. COUCH, Departments of Biochemistry and Nutrition and Poultry Science, Texas A. and M. College System, College Station, Texas

NEW NUTRIENTS ARE added to manufactured feeds through recommendations of the biochemist and the nutritionist. Very often such additions are made without regard to the difficulties imposed upon the feed control service, and similarly, the feed formulator does not fully realize the problems that fall on the shoulders of the analyst and the control inspector. During the past eight years a number of additives have been approved by the Association of Feed Control Officials, without the safeguard of adequate procedures for determining whether the manufacturer is actually following the formula and adding ingredients as indicated. Some of these nutrients are riboflavin, calcium pantothenate, niacin, choline, vitamin B_{12}, vitamin E, vitamin K, antibiotics, arsonic acids, and antioxidants.

It might be in order to discuss here the procedure necessary before an analytical method is accepted by the Association of Official Agricultural Chemists. First, the manufacturer of an ingredient presents a method to the A.O.A.C.; the method is subjected to several years of collaborative study under an associate referee, carried on in numerous laboratories, by chemists having, no doubt, varying degrees of ability. The associate referee must be assured that the method is practicable, that results are reproducible, and that determinations can be carried out routinely. After all these conditions have been met, the procedure becomes an official method of the A.O.A.C. and, as presented by the feed control official, is acceptable in court; this is the final word.

If evidence is to stand up in court, the chemist must be prepared to present unquestionable chemical determinations. The A.O.A.C. is constantly in the process of improving older established methods and devising newer practical methods for determining feed additives.

The above discussion does not mean that there are no methods for determining these new nutrients. Such methods do exist, but most of them are not applicable to the routine features necessary for determining a large number of samples with reproducible results.

Distribution and Sampling

Two persistent and perplexing problems are the distribution of an ingredient in the feed, and proper sampling to obtain an adequate sample containing a representative quantity of the additive. First, the problem of distribution might be discussed. Nutrients are added in micro quantities, and yet such quantities are apparent, as reflected by growth increases in animals and increases in reproductive ability of breeding stock. For example, vitamin B_{12} is added to poultry feeds at levels ranging from 3 to 12 mg. per ton. The feed manufacturer receives the vitamin B_{12} preparation in a carrier, but what assurance has he that the 3 mg. of the vitamin have been adequately distributed throughout the one pound of carrier? Assuming that this has been done, the next problem is the even distribution of this one pound of carrier throughout the ton of feed. The same problems exist with other additives.

The matter of sampling always comes up for discussion during A.O.A.C. meetings each year. Proper sampling and sample preparation are extremely important. The method of determining a nutrient may be practically perfect; but if the nutrient has not been distributed evenly throughout the feed and if the sample is inaccurately taken and prepared, the analyst's value will be inaccurate, not because of the assay method but owing to failure of mixing and sampling.

Biological Availability of Nutrients

Feed control laboratories are still determining protein, fat, ash, moisture, and nitrogen-free extract primarily, and calcium and phosphorus in some instances. Chemical analyses have certain very definite limitations, and the results may or may not have any relation to the actual quality of the feed. As all analysts know, protein is determined by multiplying the percent nitrogen content of the feed by 6.25, simply because most protein contains approximately 16% nitrogen. Many products contain nitrogen, but that does not tell us the biological availability of the protein. Sooner or later we shall be forced to determine some, if not all, of the essential amino acids in mixed feeds. Even if this is done, by standard microbiological procedures, again we do not know the availability of the amino acids to the animal. In time it may be necessary to determine the biological availability of the essential amino acids in mixed feeds, by present methods or by new ones to be developed through additional research.

B Vitamins in Complex Formulations

The primary problem in determining B vitamins is liberation of the free vitamin from the bound form which exists in a complex mixture of ingredients such as those in a manufactured feed. Additional research is needed before present microbiological assay methods for vitamins are acceptable in court. It is routine to determine riboflavin, niacin, pantothenic acid, choline, vitamin B_{12}

[1] Manuscript received June 4, 1956. Presented at the 41st Annual Meeting, New York, May 1956.

and others in the vitamin concentrates offered to the feed trade; but it is quite another matter to determine the content of each of these vitamins in a complex feed formulation, such as a present-day broiler feed. Methods of assay have been studied, and inter- and intralaboratory agreements are fairly consistent, but few studies have been made on samples of mixed, manufactured formulated feed.

Riboflavin and Folic Acid

Efforts have been directed toward simplifying, and reducing the time required to carry out, the determination of riboflavin in a feed ingredient or a mixed feed. Grinding the feed samples to a fine powder with a laboratory-type (Wiley) mill was found desirable. Sample size varied from 3 to 4 g. Total riboflavin content was released by steaming the mixed feed sample for 15 minutes in 0.005*N* HCl. Turbidity was removed by centrifugation (3,000 r.p.m.), and the supernatant was subjected to standard fluorometric determinations as outlined in the official A.O.A.C. method for riboflavin. The pH of this solution is approximately 4.5. Adsorption on florisil, elution with pyridine acetic acid, and oxidation with $KMnO_4$ are steps which have been eliminated. Results agreed very closely with those obtained by the standard A.O.A.C. procedure.

Folic acid, another B vitamin, is being added to commercial feeds and indicated on the control tag. Several conjugates of folic acid exist in nature. Certainly, more than one enzyme preparation is necessary for the liberation of folic acid from natural food and feedstuffs. Again the analyst must rely upon the microbiological assay.

Vitamin B_{12}

Vitamin B_{12} has been found necessary for growth and reproduction in chickens, turkeys, and four-footed animals. A microbiological method of assay, designated as official by the A.O.A.C. for test materials containing 0.1 μg. or more of B_{12} per gram, measures pseudo forms of the vitamin as well as the biologically active forms. The extent and occurrence of pseudo forms have not been completely established. This proposed A.O.A.C. method can be used with a fair degree of reliability to determine the vitamin B_{12} content of B_{12} supplements. The feed control official and the analyst must determine whether feed additives are included in the formula at the levels specified or at the level guaranteed on the control tag. If the manufacturer uses 3 mg. of vitamin B_{12} per ton, the finished feed will contain 1.5 μg. of added B_{12} per pound. How reliable is the determination of this level of B_{12} in mixed feeds by the accepted A.O.A.C. method has not been established; yet, the feed control service must determine whether the manufacturer is actually adding 3 mg. of vitamin B_{12} as guaranteed. Because vitamin B_{12} occurs naturally in fish meal, condensed fish solubles, liver meal, and meat and bone scraps, here again the problem of liberation of the vitamin from the bound forms becomes a major one, along with its actual determination by means of the standard microbiological assay.

Antibiotics

Five antibiotics accepted for general use in manufactured feeds — penicillin, terramycin, aureomycin, streptomycin, and bacitracin — produce approximately equivalent results when added to poultry feeds, in increasing weight and improving feed efficiency. Terramycin and aureomycin are generally utilized in swine feeds and concentrates and in calf feeds. Levels used have ranged from 4 to 10 g. per ton for growth stimulation, sometimes as high as 600 g. per ton for the arrest of undesignated disease levels.

Concentrations of 2 to 5 p.p.m. of an antibiotic pose several problems for the analyst: first, the low quantity; secondly the matter of distribution; and finally, sampling. Assuming that the antibiotic is evenly mixed through the feed and that sampling techniques are accurate, the quantitative extraction of an antibiotic from a sample still presents a number of problems, each of which increases the possibility of errors in the assay. At present the microbiological method is the only one available to the analyst for determining antibiotics. While it is possible to determine the antibiotic content of manufactured feeds, there is a possibility of considerable error in assays with the present techniques and these probably should not be used routinely in standard feed control laboratories until additional research and improvements are carried out.

Arsenicals

Two arsenical additives have been accepted for use in manufactured feeds: 3-nitro-4-hydroxyphenylarsonic acid and arsanilic acid. Arsonic acids are toxic above the effective level and the feed manufacturer must use the utmost caution in adding arsenicals to feeds. The arsonic acids increase growth, improve feed efficiency, and improve pigmentation in broilers; and an arsonic acid when added to a laying mash increases egg production. It is believed that these acids have an effect on sections of the undesignated disease level not touched by the antibiotics. Methods of assay for determining them are fairly well established, and are being used routinely in most feed control laboratories at the present time.

Coccidiostats

Coccidiosis continues to inflict losses in poultry production. Coccidiostats which have shown promising results are sulfonamides, phenylarsonic acids, bisphenols, carbanilide pyrimidine, and bisnitrophenyl disulfide, but caution must be exercised in adding them to poultry feeds, since in many instances there is small tolerance between the effective and the toxic level. It should be determined, of course, whether the coccidiostat has been added as claimed and, secondly, that the level of the agent added is not in the toxic range. However, methods for de-

termining the various coccidiostatic agents, worked out in the laboratories of manufacturers, do not always work well in feed control laboratories in the hands of less experienced personnel.

Stability of Vitamin A

The determination of vitamin A in a mixed feed or in a premix has always been a problem, because it is unstable when added in the form of fish oil concentrates or as synthetic material. The stability of vitamin A has been greatly improved during the past four years through addition of antioxidants and by means of protective coatings such as gelatin, pectin, a combination of a carbohydrate and gelatin, a microcrystalline wax, and fats with a high melting point. Protection against oxidation has greatly improved the possibility of the vitamin's reaching the digestive tract of the animal intact so that it can be absorbed and utilized. However, these stabilizing procedures have brought on many new problems. Because effective coatings do not permit complete extraction, a combination of saponification and extraction must be employed. Materials used for coating vitamin A quite often hinder the extraction of the vitamin from the feed. Antioxidants also have been added to stabilize provitamins A. Again, some of these interfere with the analyst's efforts in determining carotene.

Vitamins D_2 and D_3

Two vitamin D's are offered to the feed trade — D_2 and D_3. Vitamin D_2 is used in feeds for four-footed animals and the rat can be used for assaying these preparations. Because the chick cannot utilize vitamin D_2 as well as vitamin D_3, the latter is used in poultry feeds. The only method of determining the vitamin D_3 content of a concentrate or a mixed feed is the chick assay. These biological methods are expensive, and error in such assays tends to be greater than is apparent in microbiological and chemical assays.

Vitamins E and K

Vitamin E, which has been added to mixed feeds routinely for approximately two years, is effective in preventing nutritional encephalomalacia or "crazy chick disease." Antioxidants such as butylated hydroxytoluene also help through protecting the vitamin E present in the natural basal diet. Research, no doubt, will continue for some time on the determination of vitamin E in concentrates and in poultry feeds. There are a number of naturally occurring tocopherols and stereoisomers in feed ingredients. Synthetic tocopherol in various forms is also being offered. The most accurate assay for vitamin E is the biological rat assay and the chemical method which employs a molecular still is the most reliable one; both methods are time-consuming and expensive.

"Hemorrhagic disease," a condition characterized by a series of hemorrhages in muscular tissue, was first observed by poultry pathologists about 1953. It is believed that this disease, as diagnosed under field conditions, is caused by capillary fragility and has no relationship to vitamin K, since it has occurred where vitamin K in some form was being added to a broiler feed formula. Interest in prevention has led manufacturers to add vitamin K-active compounds to poultry feeds. Such addition is certainly indicated when the formula does not contain a source of vitamin K such as alfalfa or fish meal in adequate quantities to meet the needs of the birds. Thus, the vitamin should be added to mixed feed where needed, but not for the purpose of preventing field hemorrhagic disease. The chick assay is the most reliable measure of vitamin K activity of a feed or of a concentrate; it is expensive, but provides the analyst and the feed control official with a true biological evaluation of vitamin K activity.

Phosphorus

No chemical methods are available at the moment for determining the biological availability of phosphorus, despite much research based on different types of phosphorus-containing feed ingredients. While the phosphorus content of a supplement or a premix can be determined reliably, no information emerges as to the availability of the phosphorus. Biochemical feeding experiments provide the only information to answer this question so far.

Hormone Deposition

The newest problem is that of adding a synthetic estrogen, diethylstilbestrol, to cattle feeds. This is an extremely dangerous drug, from the standpoint of human consumption of the meat, and the Food and Drug Administration has watched its use very carefully. Methods are at hand for determining the diethylstilbestrol content of a premix, but, except for a mouse biological assay, there is none for detecting the deposition of the hormone.

These, then, are some of the problems confronting the feed control official and the chemist. Research on the determination of various micronutrients has not kept pace with new developments in the biochemical and nutrition fields. Feed control laboratories will have to concentrate on working out new methods and applying present methods to routine use, in order to better discharge their duties of serving the feed industry, animal producers, and poultrymen.

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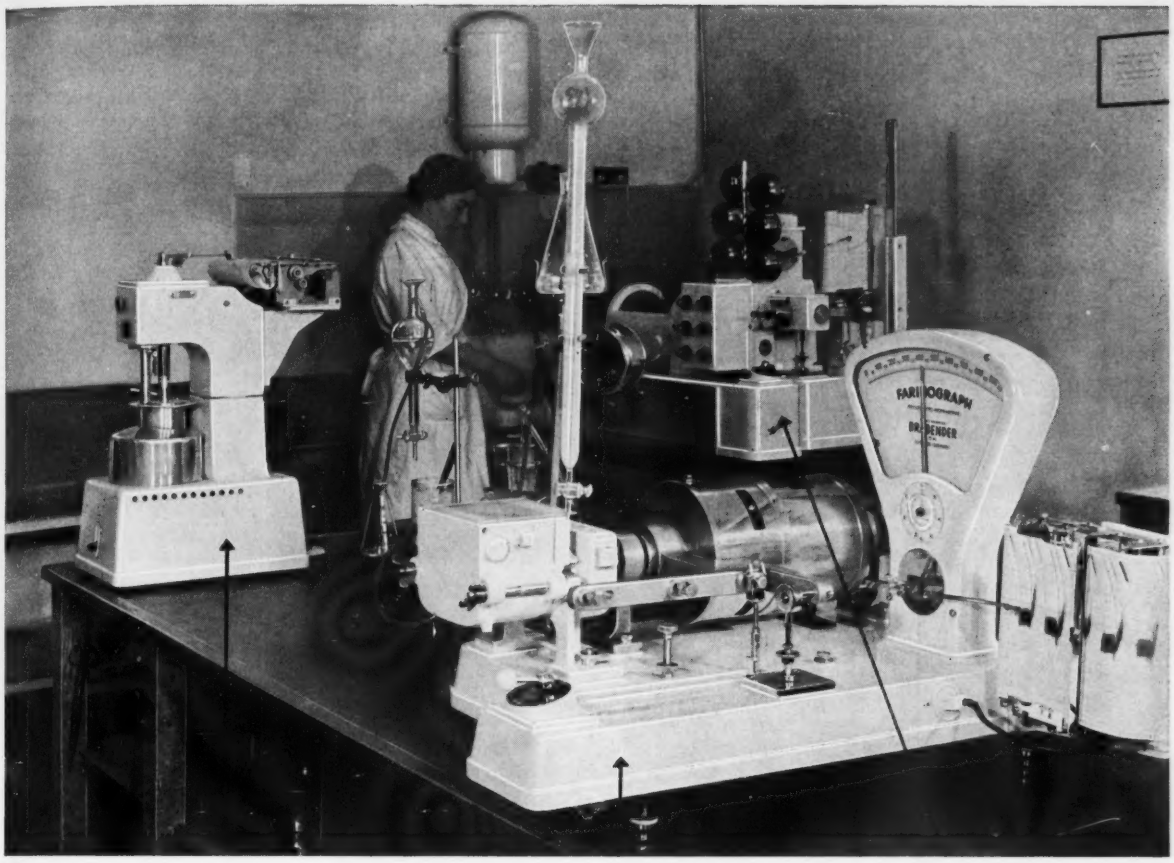
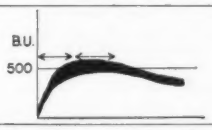
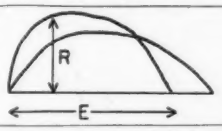
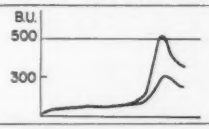


Brabender Amylograph Brabender Farinograph Brabender Extensigraf

A Typical Brabender Flour and Dough Testing Laboratory Using *the Three-Phase Conception of* Baking Performance

	I PHASE Dough Mixing	II PHASE Fermentation & Machining	III PHASE Oven Period
Measuring Instr. Used	***Farinograph***	***Extensigraf***	***Amylograph***
Type of Indication			
Information Obtained	Absorption, mixing time, mixing tolerance (general strength)	$\frac{R}{E} = \frac{\text{Resistance}}{\text{Extensibility}} = \text{Degree of Maturing}$ (Indicating fermentation and machining behavior)	Crumb formation characteristics (Controlling crumb softness and rate of staling)
Correction Possibilities in a flour mill:	Changes in wheat blend	Adjustment in "bleach" (chemical maturing agents)	Mill stream switching and/or malt additions (diastasing)
in a bakery:	Absorption and mixing changes	Adjustment of yeast food	Malt additions

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the President's Corner

news of the association

It was my privilege recently to attend the Annual Tri-Section Meeting at Manhattan, Kansas, and the meetings of the Canadian Prairie Section at Winnipeg and Northwest Section at Minneapolis. All of the meetings were well attended and a real inspiration.

Particular mention should be made of the technical program of the Tri-Section meeting, which consisted of a symposium on ionizing radiations and their effect on cereal products. Potent new tools for both research and industrial application in the cereal field have become available, largely as a result of the atomic age. This field is so new to cereal science that most of us have never received formal training in it. It therefore behooves us as cereal chemists to become acquainted with this subject and to keep up to date with it so that we shall have a full appreciation of what is being done and of the potential use of radiation in cereal research and technology. Training in the field of nuclear physics will rapidly become more and more important to food and agricultural scientists. We can do our part to harness the power of the atom for the benefit of mankind rather than for his destruction.

Let me take this opportunity in behalf of the officers and editorial staff of your Association to wish all of you a very merry Christmas and a happy and successful New Year.

LAWRENCE ZELENY

A.A.C.C.

LOCAL SECTIONS

The 28th annual Tri-Section Meeting was held in Manhattan, Kansas, October 5 and 6. Nebraska, Kansas City, and Pioneer Sections participated, and the meeting was sponsored by the Department of Flour and Feed Milling Industries of Kansas State College, Manhattan.

A. D. Weber, Dean of Agriculture, told the assembly that the next 50 years will bring many changes to Midwestern agriculture. He noted a growing demand for cereals and livestock products, and predicted that "there will be an increasing demand for personnel by the agricultural processing industries."

Lawrence Zeleny and Clinton Brooke, A.A.C.C. president and secretary, respectively, presented charters to the three sections.

Scenes from the Tri-Section Meeting at Manhattan, Kansas. Top, left to right, Dr. John A. Johnson, Dept. of Flour and Feed Milling Industries, Kansas State College and Dr. A. D. Weber, Dean of Agriculture, Kansas State College, Manhattan.

Bottom, left to right, Dr. Max Milner, Kansas State College, Dr. Chas. S. McWilliams, Quartermaster Research and Development Command, and Dr. Kenneth Gilles, Research Laboratory, General Mills, Inc.

Saturday morning's program was a symposium on ionizing radiation of foods. Speakers were R. H. McFarland, Kansas State College, Physics Department; Kenneth Gilles, General Mills, Minneapolis; Charles S. McWilliams, Army Quartermaster Research and Development Command, Chicago; and Max Milner, Department of Flour and Feed Milling Industries, Kansas State College. A review by Dr. Zeleny of problems of the association at noon luncheon concluded the meeting.

• • • •

Cincinnati Section and Ohio Valley district, Association of Operative Millers, held their thirteenth annual joint meeting at Marion, Ohio, September 28 and 29.

A technical program centered on grain storage and aeration, and a milling and baking forum composed of millers and chemists discussed the characteristics of the 1956 wheat crop.

Wives were entertained with a tour through the Harding Museum Home and Harding Memorial.

Chesapeake Section held its regular monthly meeting October 25 at Marty's Restaurant in Baltimore, Maryland. The after-dinner speaker was William J. Scarlett of the Industrial Division of Minneapolis-Honeywell. He talked on "Instrumentation in the cereal industry."

The next meeting will be at 6:30 p.m. on November 29 at the Agricultural Research Center, Beltsville, Maryland. Phil MacDonald of the American Institute of Baking will speak on "Functions of the institute with emphasis on sanitation aspects."

• • • •

The New York Section will hold its monthly dinner meeting at 6:30 p.m. on Tuesday, December 11, at Hotel George Washington, Lexington avenue at 23rd Street. Guest speaker Leland A. Underkofler of the Takamine Laboratory in Clifton, New Jersey, will speak on "Production and application of microbial enzymes." Dr. Underkofler, formerly professor of Chemistry at Iowa State University, has been director of research at the Takamine Laboratory since 1955.

• • • •

The Midwest Section opened the Christmas season with a gala evening on December 3rd. The Social Hour started at 5:30 p.m. with both wives and husbands of members attending. The dinner took place at 6:30 p.m. after which all present enjoyed the featured presentation of the evening, Dr. Llewellyn Heard of Standard Oil and his "Fire Magic." Dr. Heard has presented the story of combustion to some 7,754,000 people. With smoke rings, green flames, and minor explosions he goes about explaining the story of fire and how man controls it.

. . . People

Raymond T. Bohn recently returned from England where he was visiting cereal laboratories and bakeries. Bohn is president of Bohn Food Research, Woodside, Long Island, N. Y.

Joseph B. Burt has been elected president of the American Pharmaceutical Association for 1957-58. **J. Warren Lansdowne** was elected first vice president, and **Leroy A. Weidle, Sr.**, second vice president.

Conrad A. Elvehjem, dean of the graduate school of the University of Wisconsin, has been awarded the Charles F. Spencer Award by the Kansas City Section of the American Chemical Society. The award is conferred for meritorious contribution to the field of agricultural and food chemistry, and consists of a medallion and $500. It was presented November 9 in Kansas City.

Elvehjem and his coworkers showed that nicotinin acid was the specific antipellagra vitamin in the soil.

Philip P. Gray, Chief Chemist of Wallerstein Laboratories since 1934, has been elected a Vice President of Wallerstein Company, Inc., New York.

Paul H. Harvey, head of the Department of Field Crops at North Carolina State College, received the 1956 annual national award for distinguished service to agriculture from Gamma Sigma Delta, national honor society of agriculture, at a banquet at the college October 10.

Dr. Harvey received the honor for development of twelve corn hybrids adapted to the southeast states. It is estimated that the hybrids have added several million dollars to the annual income of farmers of that area. One of his hybrids is being grown on approximately 300,000 acres in North Carolina.

John J. Hill, aged 77, died October 20 at Rockville Center, L. I. At the time of his death, Mr. Hill was sales representative for Larvacide Products, Inc., of New York and California. Before that he was Chief Engineer for James Stewart Co., New York. Mr. Hill graduated from the University of Syracuse in the class of 1906.

. . . Products

The D. William Fuller Co. of 2320 East 75th St., Chicago 49, Ill., has developed ultraviolet equipment for protecting liquid sugar or corn syrup while in the tanks. The equipment will circulate air inside the tanks, eliminating yeast and mold growth from top and sides of the liquid sugar tank, and condensation from top and sides of the corn syrup tank. It will also keep the inside of the tank below the dew point, thus preventing condensed drops from diluting the surface of the material inside the tank.

• • •

Wilkens-Anderson has published a new Semi-Micro Catalog illustrating and describing all types of special semimicro glassware and equipment items adaptable to micro and semimicro techniques. For a free copy write Wilkens-Anderson, 4525 W. Division, Chicago 51, Ill.

. . . Patter

The Second National Grain Sanitation Conference was held in Kansas City on Monday and Tuesday, November 12 and 13, cosponsored by the Millers National Federation and the Association of Operative Millers.

This conference was designed to bring participants up to date on methods and techniques of reducing contamination in grain and grain products. Nearly all practical phases of grain sanitation were covered. The 22 speakers, without exception, were outstanding authorities on their topics.

Arbeitsgemeinschaft Getreideforschung E. V., Detmold, Germany, announces a tentative schedule of meetings to be held during the coming year, with dates and subjects as follows: At or near the beginning of May, starch; June 4-6, cereal chemistry; September 24-26, baking; October 16-18, milling.

• • •

A new "push-button" feed mill will be constructed in 1957 for the Ful-O-Pep division of Quaker Oats Company at Shiremanstown, Pa.

Mill equipment will include facilities for pneumatic loading and unloading of boxcars and trucks. Production machinery will contain "built-in" quality-control devices to assure uniform blending of ingredients.

Dublin Symposium

(Continued from page 190)

ness that cannot be associated with high maltose flours but which causes the baker much difficulty in slicing bread.

There is evidence, Mr. Coppock said, that in England the gas-producing power of baker's yeast has improved over the last two years; thus with certain samples of yeast the proportions (percent of weight of flour, to nearest 0.05%) required to produce a standard volume of gas at various stages of dough fermentation were:

Year	*Fermentation stage*		*Hours*
	1st	*4th*	*0–5*
	%	%	%
1954	1.45	1.25	1.25
1956	1.0	0.9	0.9

These results were supported by measurements of rise in proof, height of loaf, and oven spring.

There is in fact a trend towards the use of faster yeasts and shorter fermentation periods in the baking industry because of the general pressure towards both shorter working hours and saving in building space. The question arises, however, whether other factors, such as softness of crumb and flavor, should not be given at least equal weight in appraising yeast quality; noteworthy, for example, in this respect was the paper by F. W. Beech of Long Ashton, "Yeast control in cider fermentation," describing assessments of cider flavor and discussing the effect of the nature of the yeasts and the growth conditions involved.

UN WORK IN THE MIDDLE EAST

One of our long time A.A.C.C. members, Perie Rumold, who was for years associated with the Standard Milling Co. in Kansas City and is now on a UN assignment in Beirut, Lebanon, has written recently about his work with UNRWA. I am sure his many friends and acquantances would be interested to hear something about his present activities, which are of general interest as well.

The work takes him to Jordan, Syria, and Egypt as well as Lebanon, to check and control the quality of goods distributed to Arab refugees of Palestine. About 900,000 rations a month are given out, consuming approximately 110,000 tons of flour, 5000 tons of sugar, 3000 tons of rice, 3500 tons of burghol (boiled, dried, and crushed wheat), 8000 tons of pulses (beans, broadbeans, chickpeas, lentils, etc.), 4000 tons of fats and oils, and 1500 tons of soap and (during the winter months) kerosene.

"After arriving in Beirut," Mr. Rumold writes, "I set up a laboratory for making routine ash and moisture tests for flour. Now we have facilities for running soap and protein analyses, making bake tests, checking fats, ets. Managed to obtain a couple of grain dividers and a set of screens for work with pulses. . . . I have a fully trained, all-round chemist to take care of the routine laboratory work . . . and spend most of my time following up actual deliveries of goods. . . . I am constantly being asked by our Supply and Procurement Divisions to assist them in their problems and to offer advice. . . . We are offered goods at times as donations which do not exactly conform to our specifications, but can be purchased to use up different kinds of currency. Because of certain political aspects of the job . . . we are more or less obliged to cooperate with different governments."

After telling about the usual mode of travel in his jaunts about the countries, Mr. Rumold went on to describe the areas in which he gets about. "I am now on board our UN plane bound for Anman, Jordan . . . a two-motor DC-48 or some variation of this model . . . chartered primarily to take urgent supplies and personnel in and out of Gaza where there are no commercial facilities except a train to Cairo which takes about 14 hours and on hard seats throughout the night. The plane service also includes trips to Anman and Jerusalem (Arab portions) three times a week. . . .

"Beirut is on the Mediterranean seacoast, on a narrow strip of land below the mountains. Taking off from Beirut you normally fly out over the sea and then turn back and cross over two series of mountains before passing over Damascus. From there you turn south and pass over plains to the Jordan border," then over rough and semiarid country to Anman.

"Anman is a city of about 200,000 located in the eastern portion of Jordan and just on the edge of the rainfall belt," with almost complete desert extending from about 10 miles east of Anman.

There is considerable rainfall during the winter and early spring (approximately November 15 to April 15), but none during the remaining months, "so crops, trees, etc., must draw on reserve soil moisture to survive. A little water is available for irrigation from springs, wells, and meager mountain streams." The excess winter rainfall flows into the sea. "The terrain is so rough in most places that dams are not practical. One or two projects are under way to provide water for irrigation and electrical power. . . .

"The winter months along the coast are semitropical and many vegetables, bananas, oranges, lemons, grapefruit, etc., are grown. . . . Spring and summer months bring all kinds of fruits and vegetables. . . . The terraced mountains are covered (many places) with apple, cherry, peach, and almond trees, and grapevines. Olives are grown over a wide area. . . ."

"Syria is, for the most part, similar to many parts of Colorado. There is sufficient rainfall during the winter months to allow a fair crop of wheat, lentils, barley, and chickpeas to be grown. A few spots have favorable types of soil for growing melons and these are a profitable crop and well liked by the natives.

"Syria raises a rather substantial amount of durum wheat, a lot of which would make excellent semolina. In fact when they have a surplus wheat crop, some durum wheat is exported to Europe" where it is milled and made into spaghetti and macaroni.

Writing on October 2, 1956, Mr. Rumold added that "if things remain as they are now, I will likely be home on leave next fall. Will probably leave here in September and arrive in the U.S.A. some time in October and return to Beirut about the end of November."

That things should remain in any kind of status quo seems to be too much to expect of that part of the world, but we may nevertheless entertain the hope that Mr. Rumold will make his proposed trip next year.

R. K. DURHAM

N.Y. SECTION HEARS QUALITY CONTROL TALK

David Schwartz, Director of Quality Control at the Doughnut Corporation of America, spoke at the November meeting of the New York Section of the A.A.C.C. He discussed fundamental aspects of Quality Control, citing a definite trend toward "the engineering approach."

Mr. Schwartz said that in order to achieve predictable uniformity of product, test data on successive runs must show a statistical state of control so one may define control limits. If test results of production runs fall within these limits, a state of quality control exists. Successive differences may be charted from one run to the next, and long-term shifts furnish a basis for correcting the operation.

He described two key problems which must be overcome before an acceptable control program can be started. 1) methods must be sensitive to variations of production; and 2) laboratory tests should correlate with functional properties of material.

It was also suggested that a competitive, well-directed program should include wider distribution of test methods, technical seminars, and better trained technical personnel.

AUTHOR AND SUBJECT INDEX

CEREAL SCIENCE TODAY

Volume 1, 1956

Author Index, Volume 1, 1956

Subject Index, Volume 1, 1956

Observations

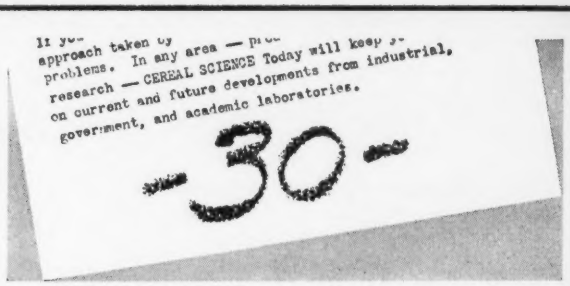
On July 22, 1956, a new law became effective concerning chemical residues in grain. Certain fumigants such as cyanides, bromides, and piperonyl butoxide leave residues in grain which might be harmful. Others like carbon tetrachloride, ethylene dichloride, and carbon bisulfide leave no apparent residue and thus are exempt.

For the past several years Food and Drug, in co-operation with the grain industry, has established standards for the safe use of chemicals in stored grain, set up on maximum residual allowances in parts per million. This opens up a new field of chemical analysis for the cereal chemist.

Methods of analysis of residuals in grain are now fairly well standardized; however, there is considerable need for collaborative study to set up what I choose to call foolproof methods, for many grain and milling chemists will be setting up procedures for this meticulous type of analysis.

This is another of the challenges that confronts the cereal chemist, making his work so interesting. As these new procedures come along we should make every effort to meet the challenge and do our part in perfecting procedures. To improve our position in the industry we must always be ready to accept new responsibilities and make the importance of our jobs apparent to management. With this thought in mind we offer to collaborate with any cereal laboratory in establishing procedures which will give us good interlaboratory check results. Our prestige and our Association move ahead only as we accept responsibility.

Jim Doty



VOLUME 1

As we write this final page to the first volume of *Cereal Science Today*, the question uppermost in our mind is "Have we been successful?" Many individuals, both members and nonmembers, have taken the time to drop us a letter or a post card and express their approval. However, we know that it has not been possible to do many of the things we had hoped this first year and thus many of our friends may still feel neglected. This situation will correct itself in time but we need the help of all A.A.C.C. members to accomplish our task. Let us know what you like or don't like about CST so we may guide ourselves accordingly. It is always difficult to please a broad audience especially if the group is divided into a number of specializations such as our Association.

The staff of CST recognizes that the majority of its readers are mill chemists. However, it is also a fact that the number of feed chemists and mix chemists are growing rapidly. It is our duty to help this growth with the proper type article but at the same time to see that no other group in the A.A.C.C. is overlooked.

On behalf of the staff of the Association's business and publications office — the best of the season's greetings.

TIME MARCHES ON

Recently a number of bound volumes of A.A.C.C. publications was placed on our desk for eventual assignment to the bookshelf. In glancing through one of the tomes we noted a very interesting issue of *The News Letter* dated April 25, 1931. The copy was almost entirely devoted to the Annual Meeting that was to take place in Louisville the following month. Among the many miscellaneous items was a notice announcing the schedule of radio broadcasts for the opening day. Not only were local stations airing our sessions but networks as well! C. G. Harrel's presidential message was carried by the NBC Blue Network about noon while CBS gave the A.A.C.C. a half hour salute from 8:00 to 8:30 p.m.! Just think what a half hour on network time would cost today at that prime time slot.

OUR COVER

Photographing the unusual is daily routine for Richard Derby of the General Mills Research Laboratories. One day you might find him using the electron microscope to examine a tissue section or perhaps making 3-D slides of fungal spores. In any event Mr. Derby will be applying photography and photographic techniques to aid his colleagues in the fields of both pure and applied research.

Our cover photograph is typical of Mr. Derby's endeavors. It is a two-micron unstained section of a wheat berry enlarged approximately 750 diameters. With a series of such sections it is possible to answer many of the questions that millers have asked for years. For instance, our cover picture shows how the cell walls of the aleurone layer extend into the endosperm, indicating the type of bond at the aleurone-endosperm interface. It is this interface that is of most concern to the miller.

MORE WHEAT BERRY

For those of our readers who would like further information concerning the wheat berry and its internal structure we suggest a glance at our sister publication, *Cereal Chemistry*. The November issue now off the press contains an excellent series of four articles under the title of, "The Structure of the Mature Wheat Kernel." These papers from the Northern Utilization Research Laboratory at Peoria contain an outstanding group of photomicrographs.